

## SECTION 16123

### MEDIUM VOLTAGE POWER CABLE

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Medium Voltage Power Cable.
- B. Cable Terminations.

##### 1.2 QUALITY ASSURANCE

- A. Medium voltage cable manufacturer shall be ISO 9000 certified and shall have a documented record of at least ten major installations within the last five years.
- B. Cable termination manufacturer shall be a company specializing in the manufacture of medium voltage power cable terminations with a documented record of at least ten major installations within the last five years.
- C. Each contractor employee that terminates or splices medium voltage cable on this project shall have attended a minimum 4 hour "hands-on" training seminar conducted by the termination or splicing material manufacturer. Training must include installing termination or splicing materials identical to those which will be used on this project. Supply all cable samples, splice kits and termination kits required for the training.

##### 1.3 SUBMITTALS

- A. Submit according to the provisions of Sections 01300.
- B. Submit the following for medium voltage power cable.
  - 1. Catalog Data: Submit catalog data showing materials and methods of construction of cable.
  - 2. Certifications:
    - a. Submit certification of experience.
    - b. For the balance of tests required by AEIC CS6 and NEMA WC8, beyond those listed below, submit Certificates of Compliance showing conformance to these standards.
  - 3. Test Reports: Submit certified Qualification Test Reports, as required by paragraph B of AEIC CS6, including the following information:
    - a. Name of Manufacturer
    - b. Date
    - c. Cable Description
    - d. Number of Reels and Length per Reel
    - e. Applicable Specifications
    - f. Report Number

- g. DC Conductor Resistance and Temperature of Conductor
- h. AC Test Voltage and Test Duration
- i. DC Test Voltage and Test Duration
- j. Insulation Resistivity Corrected to 15.6°C
- k. X-Y Plot of Partial-Discharge Test Results

C. Submit the following for cable terminations and splices:

- 1. Catalog Data: Submit catalog data showing ratings and test sample results.
- 2. Installation Instructions.
- 3. Certifications: Submit certification of manufacturer's experience. Submit certification of training for contractor's employees that will install splices and terminations.

#### 1.4 SHIPMENT

A. Package cable according to NEMA WC26 and the following additional requirements:

- 1. Ship cable in one continuous length per reel on nonreturnable reels.
- 2. Reel drum diameters shall at least 16 times the outside diameter of the cable.
- 3. Provide protective covering for each reel.
- 4. Seal both ends of each shipping length of cable with heat shrinkable caps.
- 5. Label each reel to show the name of purchaser, purchaser's order number, cable description, cable length, and shipping weight.

#### 1.5 ACCEPTANCE, HANDLING AND STORAGE

A. Inspect every reel upon delivery to project site by carrier. Reject any reel of cable with probable cable damage as evidenced by one or more of the following:

- 1. Reel laying flat on a side.
- 2. Reel stacked or beneath other freight.
- 3. Nails driven into reel flanges.
- 4. Reel flange with mechanical damage.
- 5. Removed, strained, or damaged cable covering.
- 6. Cable end seal missing or damaged.
- 7. A reel that has been dropped.

B. Handle cable as follows:

- 1. Move reels without touching cable.
- 2. Do not crush, gouge, or impact cables.

3. Do not drag cable over sharp objects.
  4. Remove nails or staples from reel flanges.
  5. Prevent overruns when de-reeling.
  6. Observe bending radii when unreeling.
- C. Store cable as follows:
1. Store reels on a hard surface so reel flanges will not sink.
  2. Align reels flange to flange; use guards across flanges when different reel sizes are stored together.

## 1.6 ENVIRONMENTAL CONDITIONS

- A. Ambient temperature will be between 40°C and -20°C.
- B. Maximum conductor temperature will not exceed 90°C except emergency conditions.
- C. Cable and terminations will be installed, tested and operated at a nominal altitude of 7,500 ft. above sea level.

## PART 2 PRODUCTS

### 2.1 MEDIUM VOLTAGE POWER CABLE

- A. Provide 15 kV power cable that is manufactured and tested according to the following requirements.
  1. *AEIC CS6 S Specifications for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV.*
  2. *ICEA S-68-516/NEMA WC8 S Ethylene-propylene-rubber-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.*
  3. *UL listed as type MV-90 cable per Standard 1072 S Medium-Voltage Solid Dielectric.*
  4. Conductor screen, insulation, and insulation screen shall be manufactured using a triple tandem extrusion process.
- B. Conductor
  1. Conductors shall be soft drawn bare copper complying with ASTM B-3 S Standard Specification for Soft or Annealed Copper Wire.
  2. Conductors shall be Class B, concentric strand according to ASTM B-8—*Standard Specification for Concentric-Lay Stranded Copper Conductors.*
- C. Conductor Strand Screen
  1. An extruded layer of black semi-conducting thermosetting compound shall be applied over the conductors.
  2. Conductor strand screen shall have physical compatibility and electrical properties that meet the requirements of AEIC CS6.

4. Conductor strand screen shall be free-stripping from the conductor and be uniformly bonded to the insulation.
5. Conductor strand screen thickness shall meet the requirements of UL 1072, Table 10.2.

D. Insulation

1. The insulation shall be thermoset ethylene-propylene rubber meeting the electrical and physical requirements of AEIC CS6 and ICEA S-68-516/NEMA WC8.
2. The insulation level shall be 133% for use on a 13.2 kV ungrounded system. The minimum average insulation thickness shall be 220 mils. The minimum thickness at any cross-section shall be not less than 90% of the average thickness.
3. The insulation shall be suitable for operation in wet or dry locations at conductor temperatures not exceeding 90°C for normal operation, 130°C for emergency overload conditions and 250°C for short-circuit conditions.
4. The insulation shall be compounded to resist moisture, ozone, corona, and treeing. The insulation shall be contrasting in color from the strand screen and insulation screen.
5. The insulation shall be fully bonded to the conductor strand screen.

E. Insulation Screen

1. An extruded layer of black semi-conducting thermosetting compound shall be applied over the insulation.
2. Insulation screen shall have physical compatibility and electrical properties that meet the requirements of AEIC CS6.
4. Insulation screen shall be uniformly bonded to and free-stripping from the insulation in accordance with the requirements of AEIC CS6.
5. Conductor strand screen thickness shall meet the requirements of UL 1072, Table 10.2.
6. The outer surface of the insulation screen shall be printed with white ink - "Semi-Conducting-Remove when Splicing or Terminating."

F. Metallic Shield

1. A bare copper tape, 5 mils in thickness, shall be helically applied over the insulation screen with a minimum 12.5% overlap.
2. The shield tape shall be electrically continuous throughout each cable length and shall be in contact with the insulation screen.
3. The shield tape shall be applied in such a manner that electrical continuity or contiguity will not be distorted or disrupted during normal installation.

G. Jacket

1. The jacket shall be black polyvinyl chloride and shall meet the physical requirements of ICEA S-68-516/NEMA WC8 for this type of jacket.
2. The jacket thickness shall be as follows:

<u>JACKET THICKNESS (MILS)</u>	
<u>CONDUCTOR SIZE</u>	<u>MINIMUM AVERAGE</u>
4/0	80
250	80
350	80
500	80
1000	110

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**Edit 3 to match Project requirements.**

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3. The jacket shall be UL listed as sunlight resistant.

I. Identification

1. A permanent marker showing "the manufacturing company, the year of manufacture, and sequential footage number" repeated each foot shall be inserted under the copper shielding tape.
2. The following legend shall be printed every 24 inches on the jacket:  
Name of Manufacturer, Plant Number, Type of Material, Insulation Thickness, Conductor Size, Rated Voltage, UL label, and Year of Manufacture.

J. Tests

1. Tests on production samples on finished lengths or production cable to be supplied on each order will be tested following the requirements of AEIC CS6 and NEMA WC8.
2. Frequency of testing shall be according to paragraph G of AEIC CS6 and Part 6 of NEMA WC8, except that a minimum of one test of each type shall be performed for each order.

K. Manufacturers:

1. American Insulated Wire Corp.
2. Cable Corp.
3. Okonite
4. Pirelli Cable Corp.

2.2 CABLE TERMINATIONS

- A. Provide terminators for single conductor, solid insulated, tape shielded, nonmetallic jacketed type cables
- B. Terminators shall be the product of one manufacturer, furnished in kit form, suitable for type, materials and dimensions of cable terminated.
- C. Provide terminators that meet the following requirements:
  1. IEEE 48 S *Test Procedures and Requirements for High Voltage Alternating-Current Cable Terminations*; Class 1, 15 kV.
  2. IEEE Standard No. 404 S *IEEE Standard for Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V through 46000 V and Cable Joints for Use with*

Laminated Dielectric Cable Rated 2500 V through 500,000 V.

- D. Separate parts of copper and copper alloy shall not be used in contact with aluminum or aluminum alloy parts in construction or installation of terminators.
- E. Provide a UL 486A listed, copper, long barrel, two-hole lug on each cable termination.
- F. For exposed, outdoor cable terminations, provide porcelain termination kits that include a porcelain bushing with sealed top cap, mounting ring, ground stud, a rubber bottom end cap with mechanical grounding strap, stress control tape and semi-conductive tape. Provide a NEMA mounting bracket. Manufacturer: 3M "5900 Series"
- G. For terminations located indoors or within enclosures, provide one of the following type cable terminations:
  - 1. Modular, molded rubber termination consisting of stress cone, ground clamp, non-tracking rubber skirts, rubber cap and mounting bracket. Manufacturer: Elastimold "35MTG".
  - 2. Cold shrink, silicone rubber termination consisting of stress cone, ground clamp, non-tracking rubber skirts, silicone rubber tape, semi-conducting tape, and mounting bracket. Manufacturer: 3M "5630K Series"
  - 3. Heat shrinkable, rubber termination consisting of stress cone, ground clamp, non-tracking rubber skirts, and mounting bracket. Manufacturer: Raychem "Series HVT-150-SG"

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**In general, medium voltage cables should be installed without splice from termination to termination. Where splices are unavoidable, use 2.3 below. If splices not be required, delete 2.3.**  
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2.3 CABLE SPLICES

- A. Provide splices for single conductor, solid insulated, tape shielded, nonmetallic jacketed type cables.
- B. Provide splices that are the product of one manufacturer, furnished in kit form, suitable for type, materials and dimensions of cable spliced.
- C. Provide splices that meet the following requirements:
  - 1. IEEE Standard No. 404 S IEEE Standard for Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V through 46000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V through 500,000 V.
  - 2. Rated for 15 kV, ungrounded, 133% insulation level.
  - 3. Designed for direct immersion, underground, and above ground application.
- D. Separate parts of copper and copper alloy shall not be used in contact with aluminum or aluminum alloy parts in construction or installation of splices.
- E. Provide compression splice for each splice as recommended by the splice manufacturer.
- F. For in-line splices provide one of the following type cable splices:
  - 1. Modular, molded rubber splice kit that includes splice body, end caps, shield jumper and connector, connectors, and accessories. Manufacturer: 3M "5500

Series”.

2. Tape splice kit that includes semiconducting tape, rubber splicing tape, shielding braid, grounding braid, vinyl tape, and accessories. Manufacturer: 3M “5700 Series”
3. Heat shrinkable splice kit that includes stress control sleeve, splice insulating sleeve, splice insulating/conductive sleeve, outer jacket sleeve, shielding braid and mesh, and accessories. Manufacturer: Raychem “Series HVS-1520S-W”

G. For wye splices provide one of the following type cable splices:

1. Tape splice kit that includes semiconducting tape, rubber splicing tape, shielding braid, grounding braid, vinyl tape, and accessories. Manufacturer: 3M “5700 Series”
2. Heat shrinkable splice kit that includes stress control sleeves, splice insulating sleeves, splice insulating/conductive sleeves, outer jacket sleeve, shielding braid and mesh, and accessories. Manufacturer: Raychem “Series HVSY-1520S-W” with Burndy “YSH” H-tap connector.

## 2.4 FIREPROOFING TAPE

- A. Provide 30-mil, flexible elastomer tape that will expand in fire to form an insulating fire wall between fire and cable. Manufacturer: 3M “Scotch Brand 77”
- B. Provide glass cloth tape with thermosetting silicone adhesive which performs at NEMA Class H temperatures to bind fire proofing tape in place. Manufacturer: 3M “Scotch Brand 69”

## 2.5 WIRE PULLING LUBRICANT

- A. Provide wire pulling lubricant that is compatible with conductor insulation, has a maximum coefficient of friction of 0.055, and is stable up to a temperature of 180 °F.
- B. For cold weather installations, provide wire pulling lubricant suitable for conduit temperature.
- C. Manufacturer: IDEAL “Yellow 190” or “Aqua-Gel CW”

## 2.6 SMOKE AND FIRE SEALANT

- A. Provide smoke sealant and fire barrier latex caulk that has intumescent and endothermic properties and has UL Classified system ratings of up to four hours.
- B. Manufacturer: 3M, type CP 25WB+ Caulk

## 2.7 CABLE MARKERS

- A. Provide cable markers consisting of 1" high reflective yellow characters on black polyethylene background mounted on black polyethylene panels or channels.
- B. Provide mounting panels or channels of adequate length for 8 characters (e.g. **S24 A**) and suitable for attaching to cable with non-metallic tie-wraps.
- C. Manufacturers: Electromark, William Frick & Co.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Verify that conduit and duct are ready to receive cable.

### 3.2 PREPARATION

Use swab and mandrel to clean and test conduits and ducts before pulling cables.

### 3.3 INSTALLATION OF CABLES

- A. Install medium voltage cables without a splice from termination to termination. Make cable splices only where indicated on the Drawings or with specific permission from the LANL Utilities and Infrastructure Group, FSS-8.
- B. Cable bends during pulling shall be not less than 15 times cable outside diameter.
- C. Install temporary guide tubes and sheaves to prevent cutting or abrasion of cable.
- D. Do not exceed cable pulling tension allowed by smallest of following:
  - 1. Allowable sidewall load: 500 lb. per ft.
  - 2. Allowable tension on conductor: 0.008 lb. per circular mil, copper.
  - 3. Allowable tension on pulling device: Manufacturer's stated working load or ten percent of rated breaking/tensile strength.
- E. Use cable pulling compound liberally; verify compatibility with cable.
- F. Pull cables slowly and steadily using capstan:
  - 1. Do not pull faster than 50 ft. per min.
  - 2. Do not stop once pull is started, unless absolutely necessary.
  - 3. Do not stop pull overnight.
- G. If basket grips are used, after pull is completed, cut off cable 3 ft. from area of cable that basket grip covered.
- H. Seal cable ends during and after pull.
- I. Install cables in manholes along wall.
  - 1. Provide cable support brackets as required to properly support cable.
  - 2. Route cable a minimum of 3/4 of the manhole perimeter to provide sufficient spare cable for future repairs.
- J. Arrange cable in manholes to avoid interference with duct entrances.
- K. Fireproof cables and splices in manholes.
  - 1. Apply one layer of half-lapped fireproofing tape.
  - 2. Extend fireproofing 1 inch into ducts.



- 3. Extend fireproofing 1 inch into connector bodies and terminations.
- 4. Bind fireproofing tape in place with glass tape.
- L. Seal cable entry to switchgear and equipment using smoke and fire barrier sealant.
- M. In manholes, seal ducts going into buildings with a water-tight seal.

#### 3.4 TERMINATIONS AND SPLICES

- A. Terminate cables to equipment furnished under this contract.
- B. Where possible, install cables without splices. Splice cables only at locations indicated on the Drawings or specifically approved by the LANL Utilities and Infrastructure Group, FSS-8.
- C. The University will make connections to the existing electrical distribution system using materials supplied by the Contractor.
- D. Verify each termination and splice is correct for cable type, size, dimensions, and location in the circuit.
- E. Review and follow cable termination and splice manufacturer's installation instructions.
- F. Provide clean and dry work area for terminating and splicing work.
- G. Bond cable shield to ground with No. 6 AWG copper conductor at all terminations and splices.

#### 3.5 CABLE IDENTIFICATION

- A. Identify each 15 kV cable at each appearance in manholes, junction boxes, transformers, switchgear and riser poles.
- B. Mark each cable with the circuit number and phase letter: e.g. **S24 A, S24 B, S24 C**.
- C. Attach identification to cable with UV resistant, non-metallic tie-wraps.

#### 3.6 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Section 16950 - ELECTRICAL ACCEPTANCE TESTING.
- B. Inspect exposed cable sections for physical damage.
- C. Inspect cable for proper connections as shown on Drawings.
- D. Inspect shield grounding, cable supports, and terminations for proper installation.
- E. Perform DC high potential test of each conductor according to Section 16950.
  - 1. Test new cables after installation of terminations and splices.
  - 2. Isolate cable under test from the terminals of switchgear, transformers, surge arresters, and disconnect switches.
  - 3. Ground cables and terminals not under test.
  - 4. Test new cables and terminations to 64 kV DC for 5 minutes.

5. Where new cables are spliced to existing cables, limit test voltage to values as follows:
  - a. For existing ethylene-propylene rubber insulated cable, as specified in AEIC CS-6.
  - b. For existing cross-linked polyethylene insulated cable, as specified in AEIC CS-5 *Specifications for Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV*.
  - c. For existing cable more than 5 years old, test only as recommended by LANL Utilities and Infrastructure Group, FSS-8.
- F. In the event that a contractor installed cable fails the field inspection and testing, remove the entire cable, install new cable and re-test.

### 3.7 PROTECTION

Protect cables from entrance of moisture before, during and after installation.

END OF SECTION